CHAPTER 12
TRACK GEOMETRY

2-1. General.

a. One rail shall be designated as the line rail. The alignment of the track is established by this rail. Either rail may be used as the line rail on tangent track so long as the same rail is used for the entire length of the tangent. The outside rail in a curve is always the line rail.

b. In curves, the inside rail is designated as the grade rail. The grade rail is the reference from which superelevation is applied to the outside rail of the curve.

c. During routine track inspections, track geometry measurements shall be taken as a minimum at the following locations:

(1) Wherever there are visual indications of track geometry deviations.

(2) Wherever track geometry deviations were previously detected, unless the deviation has been corrected.

(3) Other locations as specified in this chapter.

12-2. Gage.

a. Definition. Gage is the distance between the two rails, measured at right angles to the rails in a plane % (0.625) inch below the top surface of the rail head, as shown in figure 12-1. Gage measurements shall include any evidence of lateral movement under load.

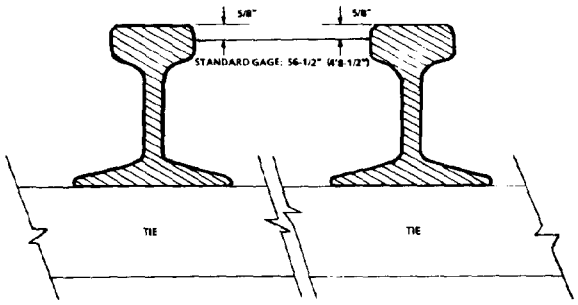

Figure 12–1. Gage measurement.

b. Measurement locations. During routine track inspections gage shall be measured at the following locations:

(1) In turnouts, just ahead of switch points. (See fig 12-2)

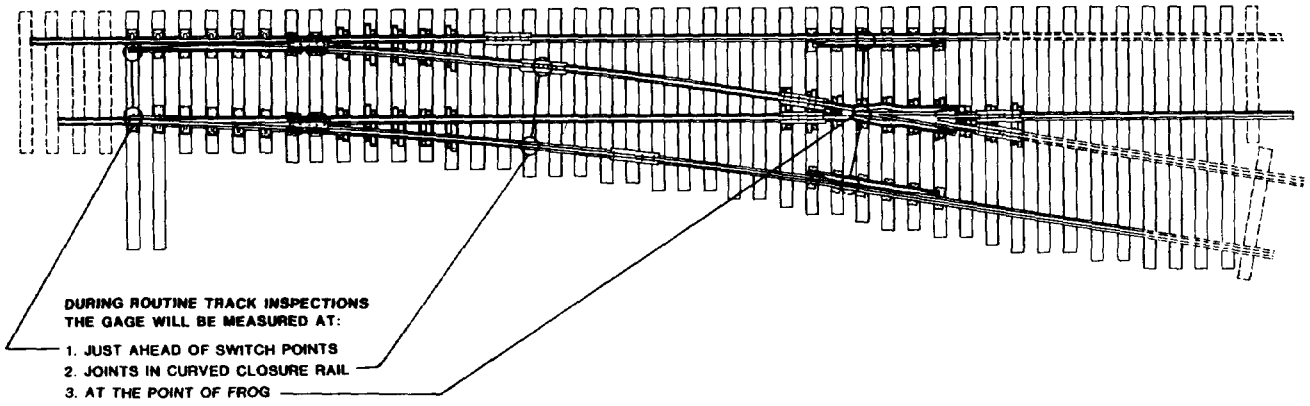

Figure 12–2. Required gage measurement locations within turnouts.

(2) In turnouts, at the joints in curved closure rails. (See fig 12—2)

(3) At the point of frog on both sides of turnouts and rail crossings. (See fig 12-2)

(4) Wherever there is a dark streak running along the field side of the top surface of the rail head.

(5) Wherever wear marks on a tie indicate lateral tie plate movement.

(6) At locations where ties are badly skewed.

(7) In road crossings.

(8) In extremely sharp curves (12 degrees or greater) gage shall be measured in at least three well-spaced locations within the curve.

c. Standard gage. Standard gage is 56½ (56.5) inches. Track will be gaged to this standard except in curves with high degrees of curvature (see table 12-1) or other unusual conditions where standard gage is not recommended by the engineer in

d. Allowable deviations and operating restrictions.

Table 12-1. Recommended gage for curved track

Degree of Curvature	*Recommended Gage, inches*
Up to 12 degrees	56½ (56.50)
Over 12 degrees up to 16 degrees	56¾ (56.75)
Over 16 degrees up to 20 degrees	57 (57.00)
Over 20 degrees	57¼ (57.25)

(1) At any location where the gage exceeds 57½ (57.50) inches, operations shall not exceed 10 mph.

(2) At any location where the gage exceeds 57¾ (57.75) inches, operations shall not exceed 5 mph.

(3) Operations shall not be permitted over any location where the gage is less than 56 (56.00) inches or greater than 58 (58.00) inches.

12-3. Crosslevel.

a. Definition. Crosslevel is the difference in elevation between the top surfaces of the two rails measured at right angles to the track, as shown in figure 12-3. Crosslevel measurements shall include any evidence of vertical movement under load.

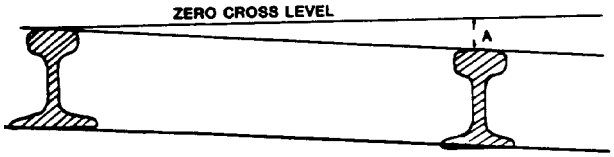

Figure 12-3. Crosslevel measurement.

b. Designated cross level. On tangent track, the designated crosslevel is zero. On curved track, the designated crosslevel is equal to the designated superelevation.

c. Allowable deviations and operating restrictions.

(1) At any location where the crosslevel deviation exceeds 1½ (1.5) inches, operations shall not exceed 10 mph.

(2) At any location where the crosslevel deviation exceeds 2½ (2.5) inches, operations shall not exceed 5 mph.

(3) Operations shall not be permitted over any location where the crosslevel deviation exceeds 3 (3.00) inches.

12-4. Superelevation.

a. Definition. Superelevation is the intended increase in elevation of the outer rail above the inner rail in a curve.

b. Maximum superelevation. The outside rail of a curve may not be lower than the inside rail or have more than 4 inches of superelevation.

c. Uniform superelevation. If a curve is superelevated, the superelevation shall be uniform throughout the curve.

d. Superelevation runoff. Superelevation runoff shall be at a uniform rate not to exceed 2 inches in any 31 feet of rail and shall extend at least the full length of the spirals.

e. Required superelevation. The required superelevation and maximum operating speeds for curved track can be determined from table 12-2.

Table 12-2. Superelevation for Curved Track

Degree of Curvature	Maximum Operating Speed, mph							
	15	20	25	30	35	40	45	50
0.50								
1.00								
1.50							0.25	0.75
2.00		NO SUPERELEVATION				0.25	0.75	1.50
2.50		REQUIRED			0.25	0.75	1.50	2.50
3.00					0.50	1.50	2.25	3.25
3.50				0.25	1.00	2.00	3.00	
4.00				0.50	1.50	2.50	3.75	
4.50				0.75	2.00	3.00		
5.00			0.25	1.25	2.25	3.50		
5.50			0.50	1.50	2.75			
6.00			0.75	1.75	3.25			
6.50			0.75	2.00	3.50			
7.00			1.00	2.50	4.00			
7.50			0.25	2.75				
8.00		0.25	1.50	3.00				
8.50		0.50	1.75	3.50	SUPERELEVATION SHALL NOT			
9.00		0.50	2.00	3.75	EXCEED 4.00 INCHES			
9.50		0.75	2.25	4.00				
10.00		0.75	2.50		Trains shall not be			
10.50		1.00	2.50		operated on curves at			
11.00		1.00	2.75		speeds which require			
11.50		1.25	3.00		more than 4 inch			
12.00		1.50	3.25		superelevation.			
13.00		1.75	3.75					
14.00	0.25	2.00						
15.00	0.50	2.25						
16.00	0.50	2.50						

Notes:

Superelevation Calculated using 2 - inch unbalanced formula, i.e.

$$E = (0.0007DV^2) - 2$$

where: E = Superelevation, inches
D = Degree of Curvature
V = Speed, mph

All values have been rounded to 1/4 inch increments

Examples:

To determine superelevation:

Enter table at maximum operating speed.
Go down to the maximum degree of curvature.

Example:

Known: Maximum operating speed: 25 mph
Existing degree of curvature: 8°
Required superelevation is 1.50 inches

To determine maximum allowable operating speed:

Enter table with degree of curvature
Go across to existing superelevation
Read maximum allowable operating speed from column heading.
Where existing superelevation falls between two table entries the lower operating speed must be used.

Example:

Known: Degree of curvature: 6°
Existing superelevation: 3"

Maximum allowable operating speed: 30 mph

Table 12-2. Superelevation for curved track.

12-5. Warp.

a. Definition. Warp is the difference in crosslevel between any two points less than or equal to 62 feet. Warp is determined as follows:

(1) Use the line rail as the reference rail.

(2) Measure the crosslevel at any two points less than 62 feet apart, normally at joints in the rail. If the reference rail is lower than the opposite rail, the sign of the measurement is negative (-). If the reference rail is higher than the opposite rail, the sign of the measurement is positive (+).

(3) To determine warp. If both signs are the same, drop the signs and subtract the smaller measurement from the larger measurement. If the signs are different, drop the signs and add the measurements. Figure 12-4 presents an example of the warp calculation.

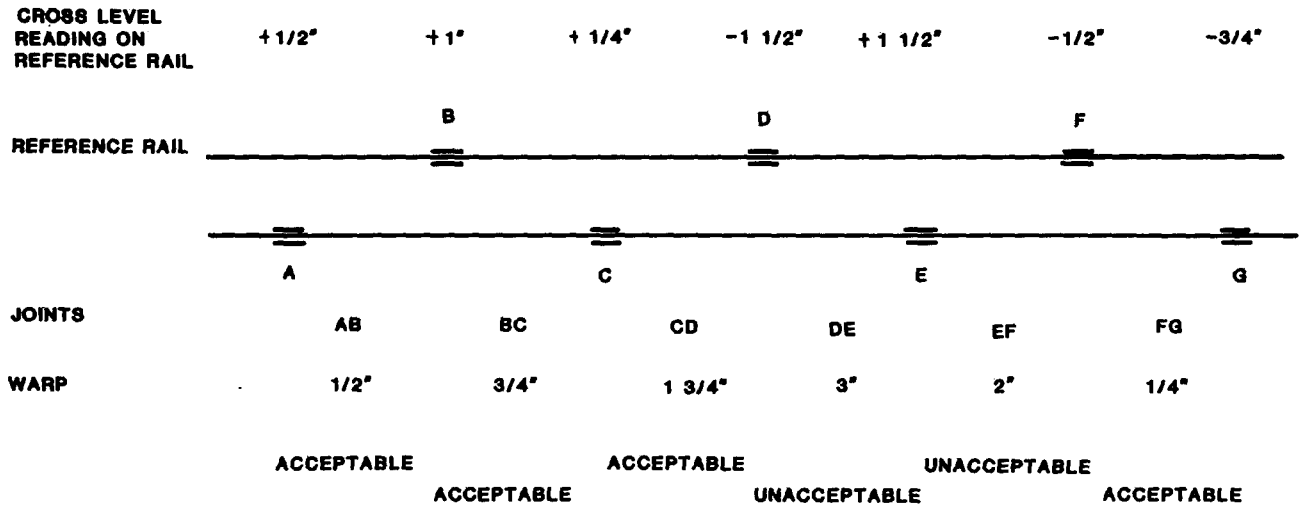

Figure 12-4. Determination of warp.

b. Designated warp. The designated warp on both tangent and curved track is zero.

c. Allowable deviations and operating restrictions.

(1) At any location where the warp exceeds 1¾ (1.75) inches, operations shall not exceed 10 mph.

(2) At any location where the warp exceeds 2½ (2.50) inches, operations shall not exceed 5 mph.

(3) Operations shall not be permitted over any location where the measured warp is greater than 3 (3.00) inches.

12-6. Alinement.

a. Definition. Alinement is the relative position of the rails in a horizontal plane.

b. Measurement. Alinement is measured at the midpoint of a 62-foot stringline stretched along the gage side of the line rail at a distance of % (0.625) inch below the top of the rail head. The alinement measurement is the distance in inches from the midpoint of the stringline to the gage side of the line rail. It is measured at right angles to the stringline.

c. Designated alinement. For tangent track the designated alinement is zero. For curved track the designated alinement is the degree of curvature. In spirals the change in curvature will be at a uniform rate.

d. Curvature measurement. On curves, 1 inch distance from the stringline to the line rail equals approximately 1 degree of curvature, as shown in figure 12-5. If the degree of curvature is not known, it can be determined as follows:

(1) Beginning at a point near the center of the curve, mark at least two stations spaced 31 feet apart in both directions along the line rail.

(2) Measure the alinement at each station, including the beginning point, and average the measurements. This average measurement is the approximate degree of curvature.

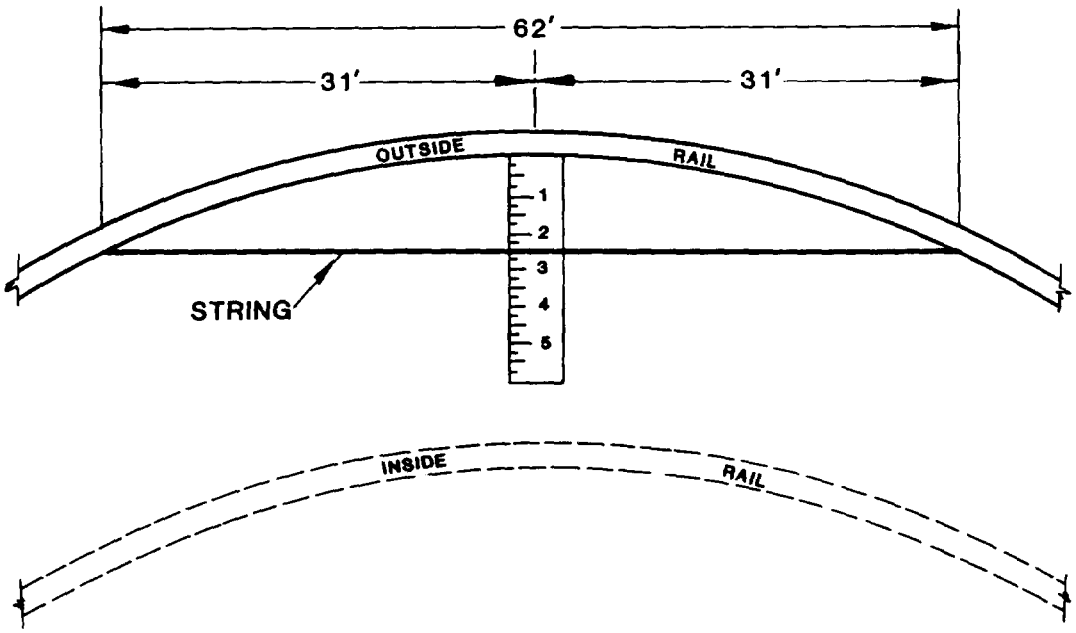

Figure 12-5. Measurement of curve alinement.

e. Allowable deviations and operating restrictions.

(1) At any location where the alinement deviation exceeds 2 (2.00) inches, operations shall not exceed 10 mph.

(2) At any location where the alinement deviation exceeds 4 (4.00) inches, operations shall not exceed 5 mph.

(3) Operations shall not be permitted over any location where the alinement deviation exceeds 5 (5.00) inches.

12-7. Profile.

a. Definition. Profile is the relative elevation of the two rails along the track. Profile deviation is the deviation from uniform profile on either rail at the midpoint of a 62-foot chord.

b. Allowable deviations and operating restrictions.

(1) At any location where the profile deviation exceeds 2½ (2.50) inches, operations shall not exceed 10 mph.

(2) At any location where the profile deviation exceeds 2¾ (2.75) inches, operations shall not exceed 5 mph.

(3) Operations shall not be permitted over any location where the measured profile deviation is greater than 3 (3.00) inches.